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PROCUREMENT OF MATERIALS REQUIRED TO FABRICATE AND TEST SPACE-QUALIFIED QUADRANT PHOTO TUBES FOR THE SHAD SATELLITE SENSOR

FINAL REPORT

CONTRACT N00014-82-C-0708

SCIENCE APPLICATIONS, INC.

SAI-83/1421

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CONTRACT N00014-82-C-0708

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Prepared by:

Science Applications, Inc.
Electronic Vision Systems Division
11526 Sorrento Valley Road, Suite A
San Diego, California 92121

Prepared for:

Office of Naval Research
Department of the Navy
800 N. Quincy Street
Arlington, Virginia 22217

SCIENCE APPLICATIONS, LA JOLLA, CALIFORNIA
ALBUQUERQUE • ANN ARBOR • ARLINGTON • ATLANTA • BOSTON • CHICAGO • HUNTSVILLE
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P.O. Box 2351, 1200 Prospect Street, La Jolla, California 92037

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1. INTRODUCTION

The work and services performed under ONR Contract N00014-28-C-0708, included several related efforts:

- (1) The engineering design of quadrant photo tubes for the SHAD Satellite Sensor. This included establishment of the engineering design of the tube structure and components to meet space qualification requirements.
- (2) Establishment of a tube encapsulation technique for quadrant photo tubes for the SHAD Satellite Sensor utilizing space-qualified encapsulation materials.
- (3) Procure all materials required to fabricate and test space-qualified quadrant photo tubes for the SHAD Satellite Sensor.

All work required by this contract has been accomplished. The engineering design and encapsulation technique have been defined. The parts required for fabrication of the quadrant photo tubes for the SHAD Satellite Sensor have been placed on order and received at SAI and are being prepared for the fabrication of those tubes.

The following sections provide discussions of the design and encapsula- techniques developed under this contract.

A separate contract, N00014-82-C-0363, has been issued by ONR to SAI for the fabrication and testing of breadboard and flight-qualified tubes using parts procured under this contract. Work on that contract is underway and the results of that effort will be described in a separate report.

2. ENGINEERING DESIGN

The design for the quadrant photo tubes for the SHAD Satellite Sensor was derived from the quadrant guider tube developed by SAI under contract to the University of Maryland. The basic design remained unchanged, although revisions were made to the internal tube structure to be more compatible with the vibration environment to be encountered. The quadrant diode array drawing was revised to specify the tighter inter-diode spacing recommended by Dr. Currie (Fig. 1).

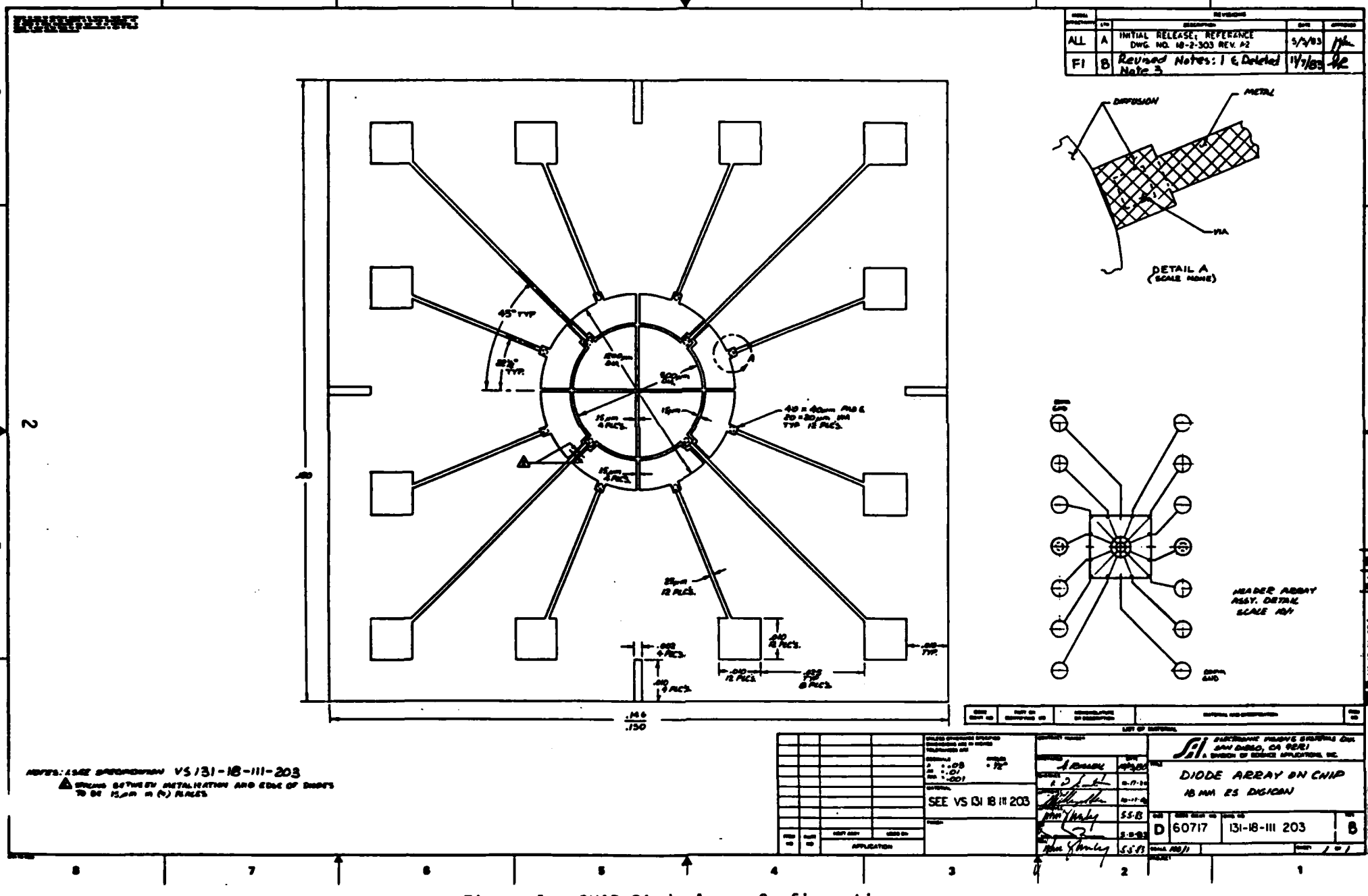


Figure 1. SHAD Diode Array Configuration.

The packaging and encapsulation design was completely revised for this application. The magnetic shield was redesigned to provide a closed shield. The encapsulant and HV cables were changed in order to be compatible with the requirement for use of space-qualified materials, and the method of attaching the High Voltage cable revised to accommodate the spacecraft's environmental requirements.

3. ENCAPSULATION TECHNIQUE

Development of encapsulation technique for the SHAD tubes was an outgrowth of SAI's experience with the encapsulation of the FOS Digicons for NASA's Space Telescope. The Space Telescope tubes, like those for SHAD, require the use of space-qualified materials compatible with high voltage operation and the contamination requirements of a space-based optical system. After considerable investigation and testing, CONAP EN-11 encapsulant was selected for use in the FOS Digicons. We elected to use this material for the SHAD tubes.

The FOS encapsulation procedure was modified as required for the encapsulation of the SHAD quadrant photo tubes. The initial encapsulated configuration is shown in Fig. 2.

As a part of Contract N00014-82-C-0363, a breadboard SHAD quadrant Photo Tube was encapsulated using this technique and tested to validate the procedure. The details of this effort will be discussed in the final report to that contract. The first breadboard tests identified two areas of the encapsulation design which required revision. There was a failure in the faceplate seal area caused by excessive stress placed on the corona shield by differential expansion over the 100°C test range. This was corrected by redesigning the shield to eliminate overhang. There was also deformation of the mu-metal magnetic shield (which also served as the potting mold in the original design) after being cycled between +55°C and -45°C. This problem was cured by casting the encapsulated tube separately, then assembling it into the magnetic shield with sufficient pre-load to compensate for the differential expansion. The second tube, which was encapsulated using this revised design, has performed well after being subjected to both temperature

MODEL EFFECT.	REVISION			
	LTR	DESCRIPTION	DATE	APPROVED
ALL	A	Initial Release, Ref. Dwg. 18-0-001	4/19/83	
ALL	B	ADD GROUND WIRE	5-4-83	

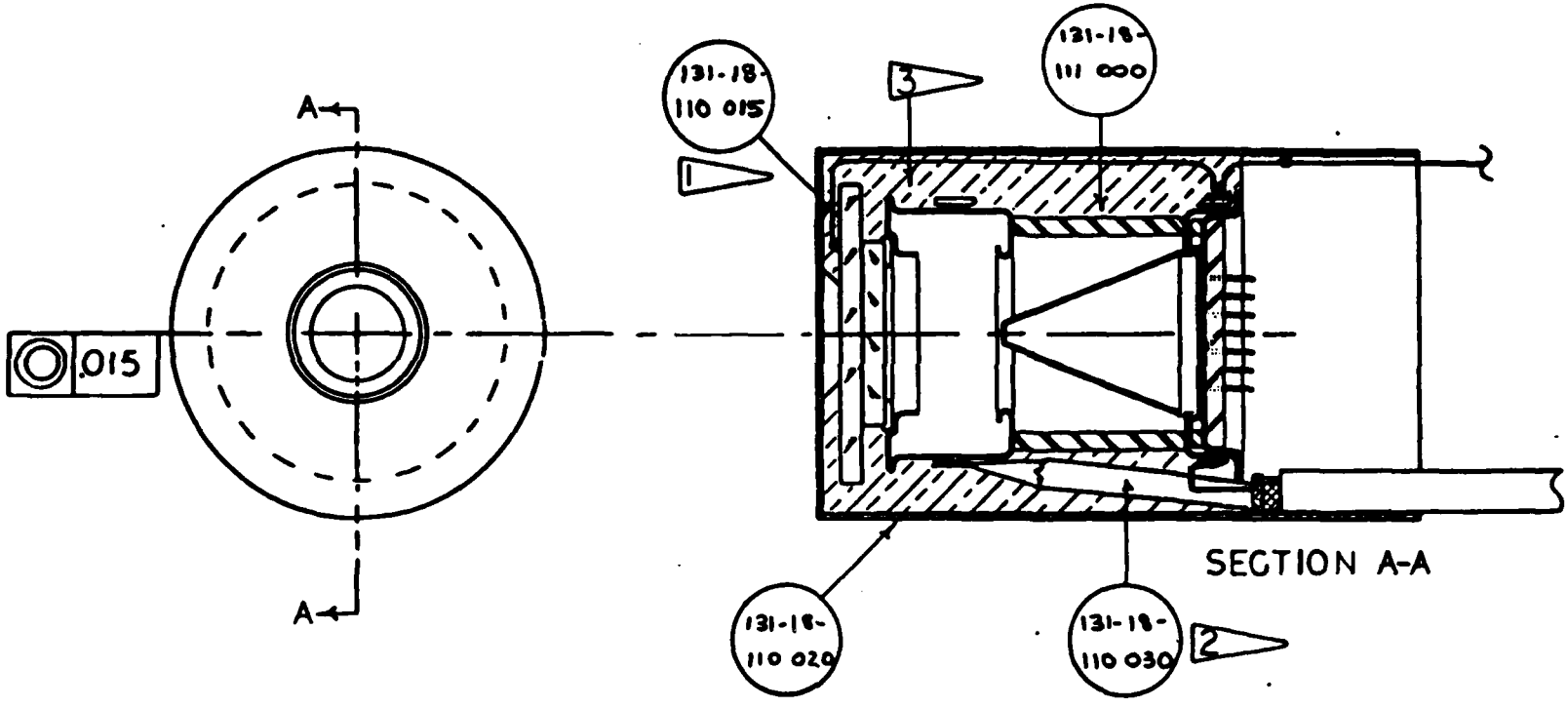


Figure 2. SHAD Digicon Original Encapsulated Configuration.

ITEM NO.	PART NO	NEXT ASSY	USED ON
		APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
DECIMALS: X ± , XX ± , XXX ±
ANGLES: ±
MATERIAL:

CONTRACT NUMBER

		DATE
PREPARED	Sam Gooch	4/19/83
CHECKED		5/2/83
APPROVED		5.2.83
APPROVED		
		4/28/83
REL		7/7/83

SAI A DIVISION OF SCIENCE APPLICATIONS, INC.

TITLE
-ENCAPSULATED GUIDER TUBE ASSEMBLY—

SIZE	CODE IDENT. NO.	DWG. NO.	REV.
A	60717	131-18-110 000	B

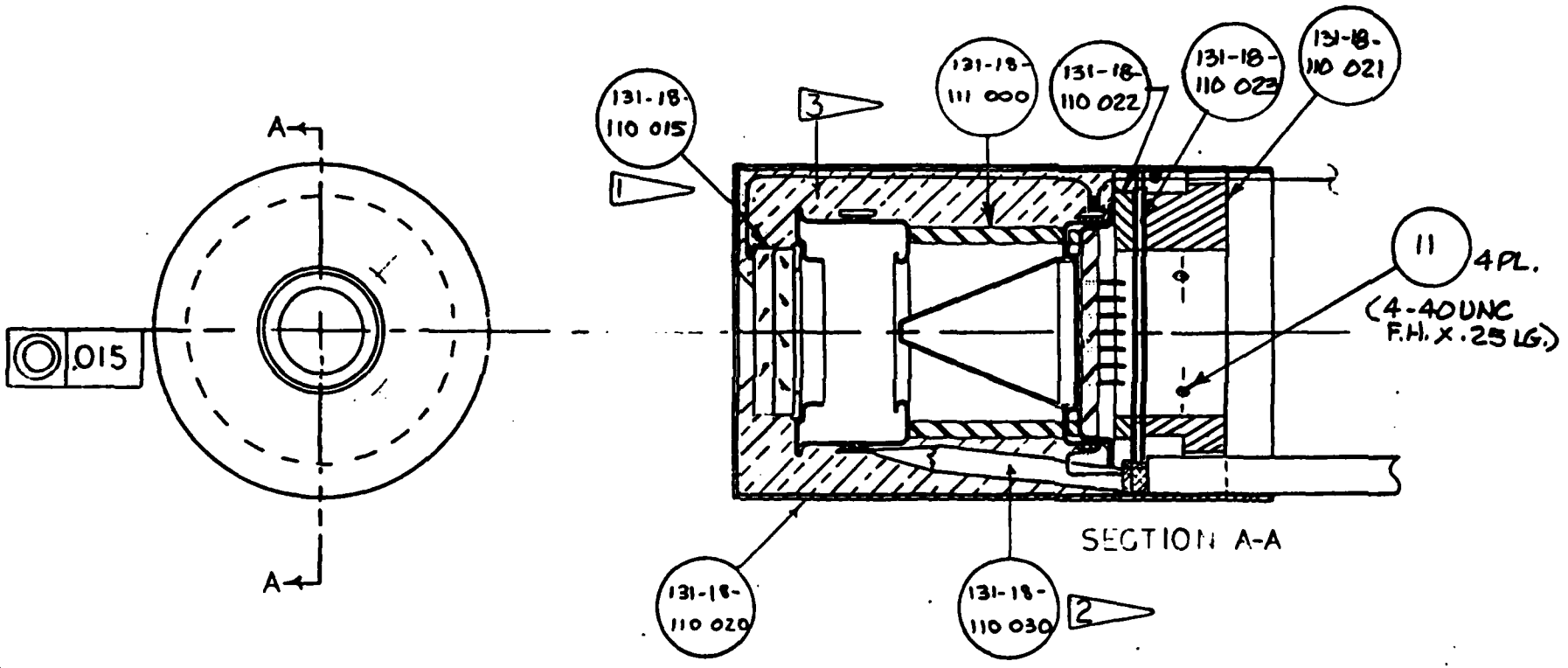
SCALE: 1/1 SHEET 2 OF 4

cycling and vibration testing. The final encapsulated configuration is shown in Fig. 3. Figure 4A and 4B illustrate the current interface for the SHAD Flight Digicon.

4. PARTS PROCUREMENT

Procurement of the materials required to fabricate and test the space-qualified quadrant photo tubes for the SHAD Satellite Sensor has been accomplished in accordance with the drawings developed under this contract. All parts have been received, inspected, accepted and are ready for the flight tubes.

MODEL EFFECT.	REVISION			
	LTR	DESCRIPTION	DATE	APPROVED
ALL	A	Initial Release, Ref. Dwg. 18-0-001	4/19/83	
ALL	B	ADD GROUND WIRE	5-4-83	
ALL	C	ADD THRUST WASHER ASSY	10/83	



UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
DECIMALS: ANGLES:
.X ±
.XX ±
.XXX ±
MATERIAL:

CONTRACT NUMBER

		DATE
PREPARED	Sam Gooch	4/19/83
CHECKED		
APPROVED		5/2/83
APPROVED		
		11-3-83
REL		7/24/84

SAI A DIVISION OF SCIENCE APPLICATIONS, INC.

TITLE
-ENCAPSULATED GUIDER TUBE ASSEMBLY-

SIZE	CODE IDENT. NO.	DWG. NO.	REV.
A	60717	131-18-110 000	C

SCALE: 1/1 SHEET 2 OF 2

ITEM NO.	PART NO.	NEXT ASSY	USED ON

Figure 3. SHAD Digicon Final Encapsulated Configuration.

MODEL EFFECT.	REVISION			
	LTR	DESCRIPTION	DATE	APPROVED
ALL	B	Revised Encapsulation Assembly	10/83	

NOTES

1. 14 Lead Dual In-Line 0.300 centers and 0.100 spacing.
2. Ground Wire 24 AWG X ~5 in.
3. High Voltage Cable 20 AWG Coax, 19/32 Strand, S.S. Braid Shield, White Teflon Insulation, 0.109 dia. X ~36 in.

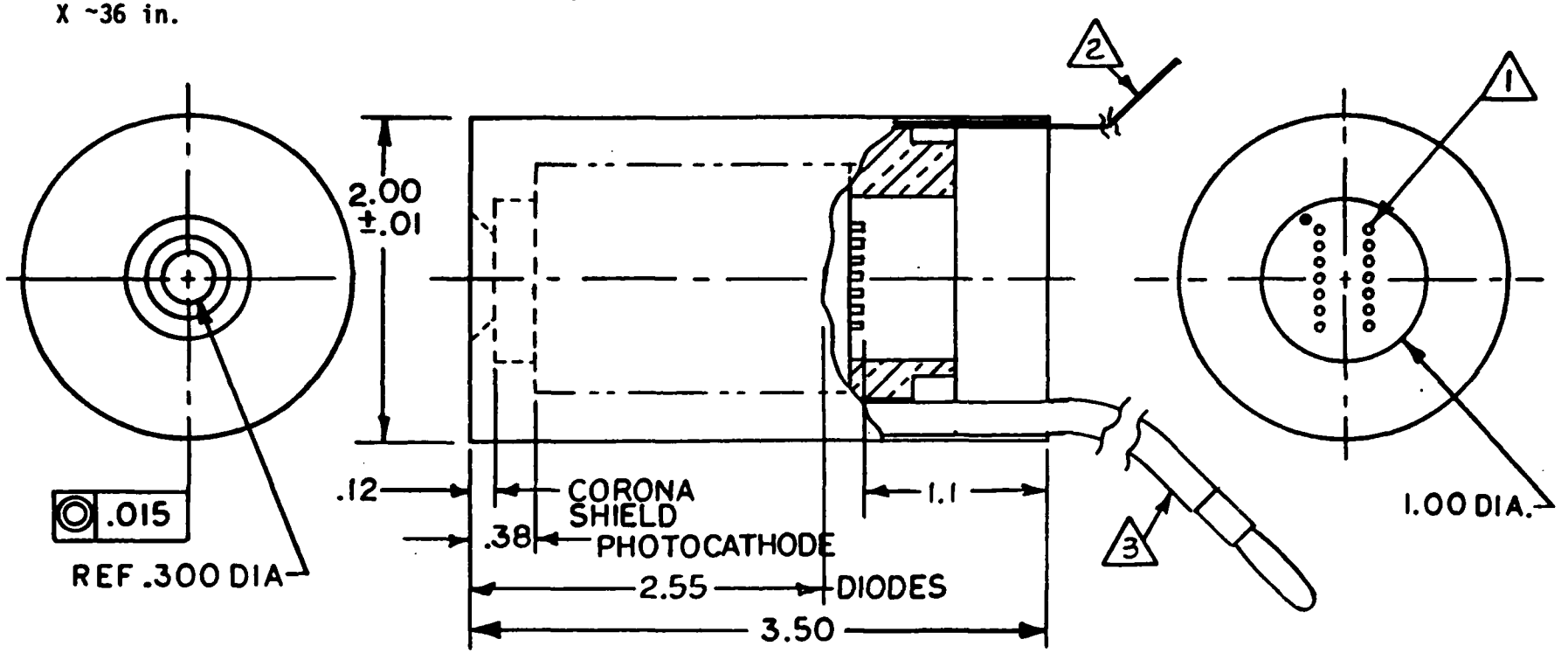


Figure 4A. SHAD Digicon Interface Drawing.

ITEM NO	PART NO	NEXT ASSY	USED ON
		APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
DECIMALS: .X ±.03, .XX ±.01, .XXX ±.005
ANGLES: ±
MATERIAL: —

CONTRACT NUMBER

		DATE
PREPARED	G. Russell	10/12/83
CHECKED	L. Colson	10/14/83
APPROVED		
APPROVED		
QA	G. Russell	10/14/83
REL		

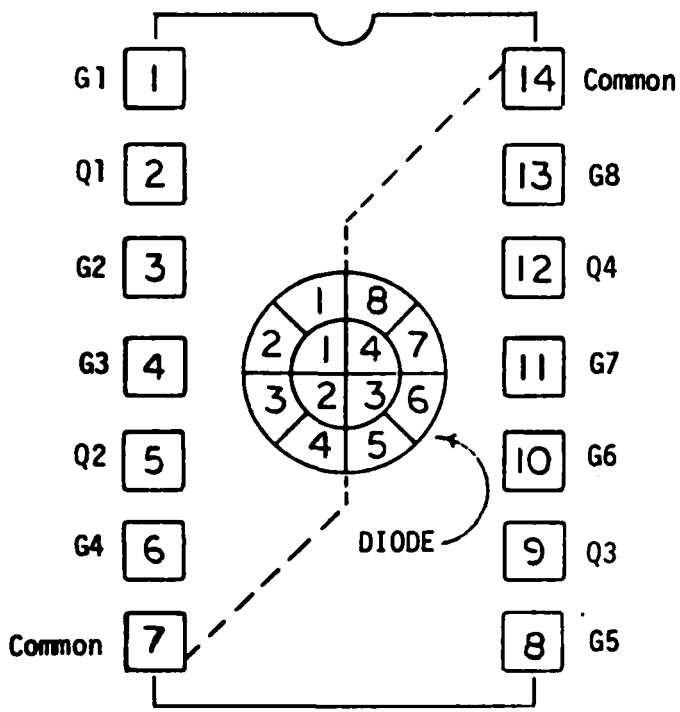
SAI A DIVISION OF SCIENCE APPLICATIONS, INC.

TITLE: INTERFACE DRAWING GUIDER TUBE ASSY

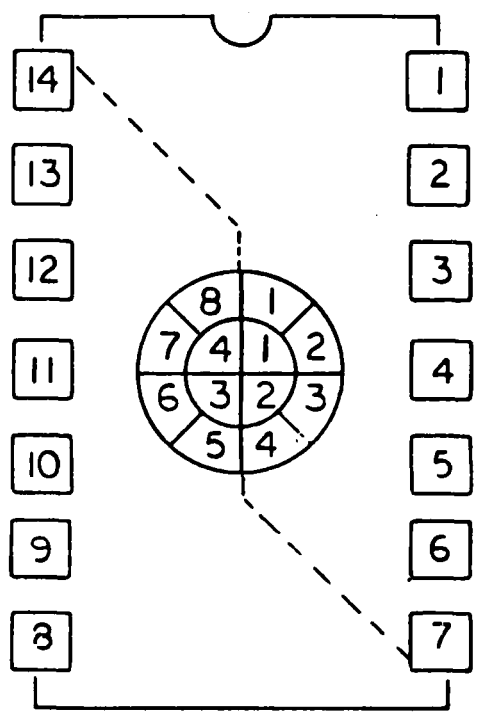
SIZE	CODE IDENT. NO.	DWG. NO.	REV.
A	60717	131-18-110 001	B

SCALE: 1/1 SHEET 1 OF 2

MODEL EFFECT.	REVISION			
	LTR	DESCRIPTION	DATE	APPROVED
ALL	A	INITIAL RELEASE	11/16	



HEADER PIN VIEW



CATHODE VIEW

ELECTRICAL SCHEMATIC

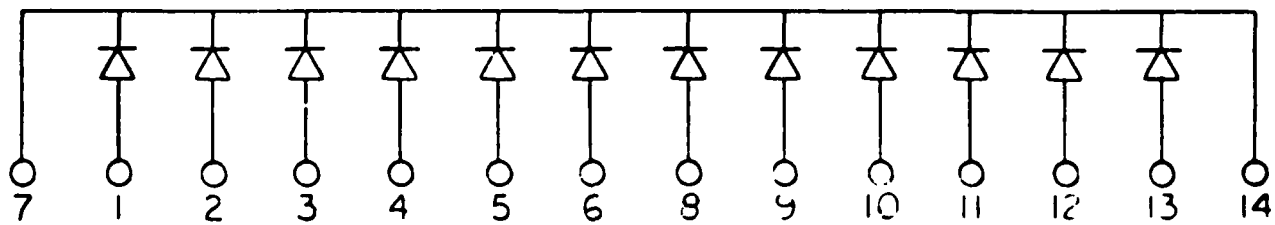


Figure 4B
SHAD Digicon Interface Drawing.

SAI A DIVISION OF SCIENCE APPLICATIONS, INC.

TITLE	SIZE	CODE IDENT.	DWG. NO.	REV.
HEADER PIN OUT, 14-PIN SOCKET 18 MM GUIDER TUBE	A	60717	131-18-110 001	A
	SCALE NONE		SHEET 2 OF 2	